United States Department of Agriculture **Forest Service** **Intermountain Region**

Forest Health Protection
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Route To:

Subject: Monitoring Biocontrol Agents in South-Central Idaho

To: Forest Supervisors, Southern Idaho

Due to the large burned areas created as a result of the wildfires in 2000, 2002, and 2003, the need for potential resources to control the spread of exotic invasive weeds into the burned areas is critical. In 2002 and 2003, Forest Health Protection, in cooperation with local land managers, monitored release sites of biocontrol insects on knapweed, leafy spurge, and Dalmatian toadflax to locate potential areas where biocontrol insects may be collected for release into sensitive burned areas where invasive species are the first colonizers. Enclosed is a report (BFO-PR-04-03) that summarizes this monitoring effort.

Please contact Rob Progar or Dayle Bennett if you need additional information or assistance.

/s/ Dayle D. Bennett (for)
WILLIAM W. BOETTCHER
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Forest Health Protection
Boise Field Office

Monitoring of Biocontrol Insect Release Sites in Southern Idaho 2002-2003

Report Number BFO-PR-04-03

INTRODUCTION

During the summers of 2002 and 2003, members of the Forest Health Protection staff from the Boise Field Office comprising Entomologist Robert Progar, and seasonal employees Jeremy Kiser, Jennifer Smith, Cindy Bagness, and Owen Shelly in 2002 and Chad Nelson and Luis Lora in 2003 monitored locations where insects were released as biological control agents on leafy spurge (*Euphorbia esula*) and diffuse and spotted knapweed (*Centaurea diffusa* and *Centaurea maculosa*).

These efforts were funded by the National Fire Plan to identify potential resources from which biocontrol insects may be collected for release into burned areas when colonized by invasive exotic weeds. With vast forest landscapes being consumed by fire in 2000 and even larger areas consumed in 2002 and 2003, the need for potential resources to control the spread of exotic invasive weeds into vulnerable burned areas is critical. Invasive weeds are frequently the first plants to colonize disturbed areas. As invasive weeds become early occupants of available niche habitats, native plant species are prohibited from returning. The potential negative impacts on native plant species, invertebrates, and vertebrates are severe. Chemical control is cost prohibitive and ecologically unsound on a landscape scale. Hence, an effective means of controlling or suppressing the impacts of the invasion of weeds in burned lands after fire is to release biocontrol agents at the leading edge of invasive weed colonization.

The release of biocontrol agents to reduce the vigor, competitive ability, and fecundity of weeds has occurred in Idaho since the mid-1970's. There have been over 800 recorded releases, with most occurring on leafy spurge and knapweed. It is suspected that many more releases have been made but were unrecorded. Additionally, after initial release, many of the over 800 recorded insect releases had no follow up and have not been monitored for insect establishment or weed impacts.

Table 1. Cooperators in the 2002 and/or 2003 monitoring of biological control insect releases on leafy spurge and knapweed.

Cooperator	Agency
Craig Nemeth	Salmon-Challis BLM
Elias Williams	Salmon-Challis BLM
Chris Tambe	Salmon-Challis BLM
Cindy Haggas	USDA–FS North Fork Ranger District
Tommy Gionet	USDA-FS Middle Fork ranger District
Rick Vanbebber	USDA-FS Malad Ranger District
Holger Jensen	USDA-FS Mackay Ranger District
Jim Hawkins	Custer County Extension Service
Earl Skeen	Custer County Extension Service
Chad Cheny	Butte County Extension Service
Robert Mickelsen	USDA-FS DuBois Ranger District
Jason Wright	Idaho Falls BLM
Charlie Swearingen	USDA-FS Idaho City Ranger District
Steve Spafford	USDA-FS Emmett Ranger District
Deb Taylor	USDA-FS Ketchum and Fairfield Ranger Districts
John Shelly	USDA-FS Fairfield Ranger District

METHODS

To assess potential resources for weed biocontrol in newly burned areas we cooperated with land managers involved in the biological control of weeds across central and southern Idaho (Table 1). To facilitate location of the release sites the land manager accompanied/ directed us to the release sites. In a few instances, maps and detailed directions were given to lead us to the release locations. This was essential because the monuments from the old releases are either missing, grown over, or otherwise very difficult to locate. The use of GPS is essential in locating many of the sites. However, most of the releases we were searching for occurred before global positioning systems were commonly used. We focused our efforts on surveying

sites that had biocontrol agents released at least 4 years ago, allowing time for insects to become established and to multiply.

We monitored 82 release sites during 2002. Thirty-five of these were infestations of leafy spurge and 47 sites were knapweed infestations. We also monitored five sites where introductions of a new insect (*Mecinus janthinus*) on Dalmatian toadflax in a cooperative effort with the University of Idaho.

In 2003, we monitored 85 release sites. Fifty-five of the sites occurred in knapweed infestations, 14 in leafy spurge, 5 in Dalmation toadflax, and 11 in areas of rush skeleton weed.

Sweep netting was the primary means used to sample for biocontrol insects. This method is very effective for sampling/collecting *Larinus* sp. on knapweed and, *Aphthona* sp. flea beetles, and *Oberea* beetles on leafy spurge. It is not very efficient in sampling *Agapeta zoegana* moths or *Cyphocleonus* weevils on knapweed. A standard protocol (Appendix 1) was used as a monitoring tool to gathered abiotic information about the release site, information on the density of the target weed and data on the target biocontrol insect. It was adequate in many respects for collecting the desired information, however, there are several modifications recommended for future monitoring efforts:

1. On sites where multiple releases were made of different biocontrol agents, the monitoring form should be able to accommodate more than one target insect.

2. There should be an entry on the form for an estimated size of the area containing weeds.

3. There should be an entry for the initial date of release so the length of time that the insects had to establish may be determined.

4. There should be criteria oriented as a checklist as noted by Sturdevant and Dewey (2002) that can assess whether the sites monitored would make a good insectory. There also needs to be space set aside for the addition of anecdotal information relative to site/weed/insect characteristics. Attached (Appendix 1) is a recommended form for use in monitoring release sites.

Leafy Spurge

Among the releases monitored on leafy spurge in 2002, three sites had collectable populations of *Oberea* and eight had collectable populations of *Aphthona* sp. flea beetles. The majority of the sites had either “established” or detectable levels of insects termed “present”. However, since we were targeting “older” releases, many of the leafy spurge release sites we visited had significantly reduced weed populations. The weed was present in small-dispersed patches rather than a large contiguous monoculture. In the presence of *Aphthona* flea beetles, insect feeding frequently causes uneven patterns in the distribution of leafy spurge. The effects of *Aphthona* sp. beetle

feeding on leafy spurge are commonly exhibited as a gradation in the density and vigor of weeds away from the point of release, frequently referred to as a “bomb blast”. When insect populations are high, the leading edge of insect feeding is commonly characterized by large numbers of adult beetles feeding on individual plants with many plants infested with beetles. Over time, *Aphthona* beetles are capable of significantly reducing a population of leafy spurge, however, the weed is not eliminated, but commonly returns in a patchy distribution of plants exhibiting low vigor because of feeding pressure exerted by the beetle. Therefore, at older release sites, beetles are present, but usually not in outbreak numbers.

It should also be noted that the abundance of beetles vary within the patch of weeds. As the leading edge of the initial insect “bomb blast” expands away from the point of release, the plants containing large numbers of insects are located further from the location where the release was made. Frequently, the entire area infested with weeds had to be searched to locate a collectable population of insects.

Aphthona populations vary with season. In south/central Idaho, the population usually peaks in early- to mid-June. Because there were so many sites to visit, we were monitoring for *Aphthona* through the end of August when populations were severely declined.

In one area, we monitored three leafy spurge sites found to have collectable populations of *Oberea erythrocephala,* a stem and root boring beetle. This beetle is able to kill leafy spurge over large areas. Eggs are laid in niches at the upper portion of the stem. In the larval stage, the insect bores down the stem to the root crown. In the process of egg laying and larval tunneling, the top of the plant is killed preventing formation of seeds. The larva overwinters in the root crown consuming most of the tissue in the root crown by the time it is fully developed. Apparently, 2 years are required for the adult to develop in North America. This insect is especially beneficial because it prevents seed formation and kills the plant by consuming root tissues.

In the 14 leafy spurge release sites we monitored in 2003, we found detectable populations at 4 sites, no biocontrol insects at 2 sites, and collectable populations at 8 sites.

Knapweed

Among the 47 knapweed sites we monitored in 2002, four were found to have collectable populations of *Larinus minutus* and one with collectable populations of *Cyphocleonus achates*. Nearly all of the sites had *Larinus minutus* present and established, however, most of the sites did not have collectable populations. A seedhead feeder, a single *Larinus* larva can destroy an entire seedhead. *Cyphocleonus achates* is a large root feeding weevil that can render considerable damage to knapweed plants (Rees et al.1996). We made observations at some sites of nearly 20 larvae feeding on a single plant

with nearly every plant having infested roots. Nine of 47 knapweed sites we visited had releases of *Cyphocleonus.* We collected weevils at few of these sites, however, because sweep netting is not the best means of surveying for the presence of *Cyphocleonus.*

In 2003 we found collectable populations of *Larinus minutus* at nine locations and collectable populations of *Cyphocleonus* at the same location as in 2002. Twenty seven sites had established populations where *Larinus* was present and no biocontrol insects were found at 19 locations

Rush Skeleton Weed

In 2003, we assisted the Middle Fork Ranger District at the Salmon-Challis National Forest by surveying for the establishment of the rust fungus (*Puccinia chondrillina*), skeleton weed gall mite (*Eriophyes chondrillae*), and (the skeleton weed gall midge (*Cystiphora schmidti*) on rush skeleton weed. The biocontrol agents were in collectable numbers at one location, present and established at six sites, and not found at four release sites.

General Observations

During the course of the 2002 and 2003 seasons, we cooperated with 15-20 different land managers across central and southern Idaho. The amount of active management using biocontrol to manage invasive weeds varied from little to a very strong program based primarily on biocontrol insects. Those land managers who actively managed the biocontrol insects had less severe weed infestations than those who either relied primarily on chemical control or those who simply released the insects and assumed that nature would take its course and the insects would eliminate the weeds. The most effective managers would closely monitor their previous release sites and upon emergence, would collect and move the insects to new infestations on areas where there were lower insect populations. These managers were supplementing existing populations with additional releases of additional insects of the same species and adding new species of biocontrol insects that attack the plant in a different point.

References

REES, N.E., QUIMBY, P.C. JR., PIPER, G.L., COOMBS, E.M., TURNER, C.E., SPENCER, N.R., AND L.V. KNUTSON. 1996. *BIOLOGICAL CONTROL OF WEEDS IN THE WEST.* WESTERN SOCIETY OF WEED SCIENCE. BOZEMAN, MONTANA.

STURDEVANT, N.J. AND J. DEWEY. 2002 EVALUATING RELEASES OF *CYPHOCLEONUS ACHATES* AND *AGAPETA ZOEGANA* AS POTENTIAL FIELD INSECTARIES AND EFFECTS OF WILDFIRE ON PREVIOUS RELEASES. FOREST HEALTH PROTECTION REPORT 02-6 JULY 2002.

BIOLOGICAL CONTROL MONITORING REPORT

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SITE INFORMATION

Monitored By: _____ **Release Date:** _____/____/____ **Monitor Date:**____/____/_____
(yyyy mm dd)

State: ____ **County:** _____ **Target Agents:** 1.)_____2.)_____3.)_____

Target Weed: _____ **Size of Infested Area (acres) :** _____ **Ease of Access:** _____

Other Agents Present:_____

Land Ownership: BIA BLM CGOV OTH PVLA STAT TNC TRIB USFS USFW USOT

Local Ownership (Optional): _____(Assign a Site Name)

UTM: UTM Datum Zone: _ _ UTM Year: _ _ _ _ UTM Easting: _ _ _ _ _ _ _ _ UTM Northing: _ _ _ _ _ _ _ _

Lat: Deg _____ Min _____ Sec _____ **Long:** Deg _____ Min _____ Sec _____

LL Datum: _____

Legal: T _____ R _____ Sec _____ Q _____ QQ _____

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MONITORING INFORMATION

Sampling Time: _____
Weather Conditions: Clear ____ Partly cloudy ____ Overcast ____ Rain ____ Other (specify) _____
Air Temperature (F): <60 ____ 60-70 ____ 70-80 ____ 80-90 ____ >90 ____ Actual Temp. _____
Wind: Calm ____ Light ____ Moderate ____ Strong ____ Gusty ____

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BIOLOGICAL CONTROL MONITORING

Visual Observation of any Biocontrol Agent Before Sampling? Yes ____ No ____
Visual Observation of Biocontrol Agent/5 Minutes: Species _____ Number _____
Seed Head Sampling: Number Sampled _____ Total Number Infested _____ Species _____
Agent Sweeping: Number of Sweeps _____ Total Number of Agents Swept _____ Species _____
Root Sampling: Number of Roots Sampled _____ Total Number Infested _____ Species _____
Estimate of Population Level: None _____ Present _____ Established _____ Marginally Collectable _____
Collectible _____
*Answer the above questions for each biocontrol organism found present on site and attach.

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VEGETATION MONITORING

Photos Taken? Yes _____ No _____
Dominant Plant: _____
Percent Canopy Cover: Tree ____ Shrub ____ Forb ____ Grass ____ Litter ____
Type of Sample: Daubenmire Frame _____ Other (specify) _____
Average Number of Target Weed Stems: _____
Average Height of Target Weed: _____
Average Percent Canopy Cover of Target Weed: _____

Enter general observations on back of page.

MONITORING INSTRUCTIONS

Visual Observation: Sit quietly for 5 minutes in the infested area near the release point and look for the insects. If you see none, then carefully and slowly move the plants aside to look under the leaves and on the stems. Record observations on monitoring worksheet. Summarize results onto page 1.

Seedhead Sampling: Lorinus spp**.** Within a 15-meter circle surrounding the release point collect 200 seedheads. Dissect the seedheads and examine for the presence of a biocontrol agent. Record on the worksheet if the seedhead is infested, the species and number of biocontrol agents present. Summarize the results onto page 1.

*If 50 percent of the seedheads are infested then the population is likely collectible.

Agent Sweeping: Lorinus or Spurge/Aphthona spp. First, look over the release area to see if biocontrol agents are visually apparent. Next, sweep five sampling points along four lines in N, S, E, and W direction from the release point (20 points total). For each line, begin 1 meter from the release point. Using a 15-inch diameter net, make four sweeps (two to right center, two to left center). Carefully examine the net and count and identify species of the biocontrol agents present, then empty the net behind you. Record on worksheet. Move 2 meters out and repeat above steps. Continue until five points have been sampled, then repeat over the remaining cardinal directions. Record on monitoring worksheet. Summarize all transect results on page 1.

*If you collect two target organisms per sweep or a total of 160 then the population is likely collectible.

Root Sampling: Chyphocleonus/Agapets/Sphenoptera Within a 15-meter circle surrounding the release point, dig roots from 20 randomly selected plants. Select plants with a root crown diameter of atleast 12 millimeters. Dissection of the roots should be done in the field for best results. If this is not possible, place the plants on ice or in a cool place for dissection later. Count the number of infested plants. Record on monitoring worksheet. Summarize results onto page 1.

*If 25 percent or more of the plants are infested; the population is likely collectable.

Vegetation Monitoring: Establish four transects, in each cardinal direction, from the release point. Place a Daubenmire frame to the right side of each transect line at a point 1, 3, 5, 7, and 9 meters. Within each frame, count the number of stems, record the average height and the percent canopy cover for the target weed. Record on monitoring worksheet and summarize the results onto page 1.

MONITORING WORKSHEET

VISUAL OBSERVATION (5 minutes)

SEED HEAD SAMPLING (Record species and number found. If seedhead is empty, leave blank).

Seed Head #	Species	#Found	Seed Head#	Species	#Found	Seed Head#	Species	#Found
1			68			135		
2			69			136		
3			70			137		
4			71			138		
5			72			139		
6			73			140		
7			74			141		
8			75			142		
9			76			143		
10			77			144		
11			78			145		
12			79			146		
13			80			147		
14			81			148		
15			82			149		
16			83			150		
17			84			151		
18			85			152		
19			86			153		
20			87			154		
21			88			155		
22			89			156		
23			90			157		
24			91			158		
25			92			159		
26			93			160		
27			94			161		
28			95			162		
29			96			163		
30			97			164		
31			98			165		
32			99			166		
33			100			167		
34			101			168		
35			102			169		
36			103			170		
37			104			171		
38			105			172		
39			106			173		
40			107			174		
41			108			175		
42			109			176		
43			110			177		
44			111			178		
45			112			179		
46			113			180		
47			114			181		
48			115			182		
49			116			183		
50			117			184		
51			118			185		
52			119			186		
53			120			187		
54			121			188		
55			122			189		
56			123			190		
57			124			191		
58			125			192		
59			126			193		
60			127			194		
61			128			195		
62			129			196		
63			130			197		
64			131			198		
65			132			199		
66			133			200		
67			134					

AGENT SWEEPING (4 sweeps at each of the 5 points per transect = 20 sweeps per transect. 4 transects x 20 sweeps per transect = 80 sweeps per release site).

Distance From Release Point	N	E	S	W
1 meter				
3 meters				
5 meters				
7 meters				
9 meters				

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ROOT SAMPLING (Samples should be taken within a 15-meter circle surrounding the release point).

Root Number	Species of Larva	Number of Larva
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

*Record: AG for Agapeta, CY for Cyphlocleonus or SP for Sphenoptera.

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VEGETATION MONITORING (Sample should be taken on the right side of transect with back to release point facing in the appropriate cardinal direction. Record Number of Stems, Average Height and Percent Cover at 1, 3, 5, 7 and 9 meters from the Release Point).

Distance From Release Point		N	E	S	W
	Number of Stems				
1 meter	Average Height				
	Percent Cover				
	Number of Stems				
3 meters	Average Height				
	Percent Cover				
	Number of Stems				
5 meters	Average Height				
	Percent Cover				
	Number of Stems				
7 meters	Average Height				
	Percent Cover				
	Number of Stems				
9 meters	Average Height				
	Percent Cover				

BIOLOGICAL CONTROL MONITORING REPORT GUIDE

Monitored By: Enter the full name (last, first, MI) of the primary individual doing the monitoring.

Release Date: Enter the date the initial release was made.

Monitor Date: Enter the date the monitoring is conducted in the following format – YYYY/MM/DD.

State: Enter the two-digit standard postal code abbreviation for the state where the biocontrol monitoring is conducted. EXAMPLE – Monitoring is conducted in Idaho, you would record; ID.

County: Enter the county where the monitoring is being done.

Target Agent: The scientific name (genus and species) of the agent(s) being monitored.

Target Weed: The scientific name (genus and species) or the common name of the target weed the agents were released to control.

Size of Area Infested: The estimated size of the area infested with weeds.

Ease of Access: One-word definition on how easy it is to locate and access the location.

Other Agents Present: The scientific name (genus and species) of other biocontrol agents released at the site.

Land Ownership: The ownership of the land where the monitoring is being done.

CODE	DESCRIPTION	CODE	DESCRIPTION
STAT	State Lands	TNC	The Nature Conservancy
BLM	Bureau of Land Management	TRIB	Tribal Lands
CGOV	County Government	USFS	United States Forest Service
OTH	Other	USFW	United States Fish and Wildlife Service
PVLA	Private Landowner	USOT	US Government (other federal lands)

Local Ownership: This field identifies state and local land managers/owners. Record a site name.

UTM or Lat/Long or Legal: On the ground point of monitoring. Locations can be described using a variety of methods; any one of the following methods may be used; UTMs, Lat-Longs, or legal.

UTM: UTM Datum Zone and year, with the easting and northing localities.

Lat/Long: Degrees, minutes, and seconds.

LL Datum: The suggested set-up for your GPS is as follows. Set the Position Format to hddd mm'ss.s. Set the Map Datum to NAD83. Set the Units to Statute Miles. Set the North Reference to True North. This is not a required set-up, but if you use something different, you need to describe it here so the exact position can be plotted on a GIS layer.

Legal: Township, Range, section, quarter section and quarter/quarter section.

MONITORING INFORMATION

Sampling Time: Time of day the monitoring is being done.

Weather Conditions: Weather conditions at the time and place the monitoring is being done. Check one of the following; clear, partly cloudy, overcast, rain or other.

Air Temperature (F): Estimate, or measure, the temperature (degrees Fahrenheit) when the monitoring is being done.

Wind: Estimate the wind speed when monitoring. Check one of the following; calm, light, moderate, strong or gusty.

BIOLOGICAL CONTROL MONITORING

Visual Observation of any Biocontrol Agent Before Sampling: Before conducting any type of monitoring, make a quick visual inspection around the release site for any biocontrol agents. Check Yes if any are observed, No if nothing is found.

Visual Observation of Biocontrol Agent/5Minutes: Complete the Visual Observation procedure described in the Monitoring Instructions. Record species and number observed.

Seed Head Sampling: Complete the Seed Head Sampling procedure described in the Monitoring Instructions. Record the total number of seed heads sampled, total number of seed heads infested and the species of biocontrol agent found.

Agent Sweeping: Complete the Agent Sampling procedure described in the Monitoring Instructions. Record total number of sweeps, total number of agents swept and species found.

Root Sampling: Complete the Root Sampling procedure described in the Monitoring Instructions. Record total number of roots sampled, total number infested and species found.

Estimate of Population Level: Follow the recommendations in the Monitoring Instructions and check none, present, established, marginally collectible or collectible.

VEGETATION MONITORING

Photos Taken: If photographs are being taken as part of the monitoring effort check Yes. If not check No.

Dominant Plant: Estimate and record the dominant plant in the general area around the release site.

Percent Canopy Cover: Estimate and record the percent canopy cover for the vegetation in the general area around the release site. Canopy cover is the percent of the ground shaded by vegetation. EXAMPLE – A grass plant is not completely shading the ground below it and gaps occur between the shaded portions. Canopy cover is assessed for the top layer of vegetation only. EXAMPLE – If a leafy spurge plant is growing over a grass plant and the grass cannot be seen when looking directly down, only the leafy spurge canopy cover is counted. The total canopy cover possible is 100 percent.

Type of Sample: Check Daubenmire Frame is one was used for vegetation monitoring. It is the preferred type of frame for vegetation monitoring. Specify the type and size of frame if a different one is used. A Daubenmire Frame is 1/10 square meter. It is a rectangle that measures 20 by 50 centimeters. They can be constructed out of 1-inch PVC pipe for less than $2. A three-sided Daubenmire Frame can be used for sampling when the vegetation is so tall it is difficult to place the frame accurately.

Average Number of Target Weed Stems: Record the average number of target weed stems per plot. Sum the total number of target weed stems recorded on the worksheet for the 20 vegetation monitoring points taken at each monitoring site and divide by 20.

Average Height of Target Weed: Record the average height of the target weed per plot. Sum the average heights recorded for the 20 vegetation monitoring points taken at each monitoring site and divide by 20.

Average Percent Canopy Cover of Target Weed: Record the average percent canopy cover of the target weed per plot. Sum the percent canopy covers recorded on the worksheet for the 20 vegetation monitoring points and divide by 20.